FIG. 1

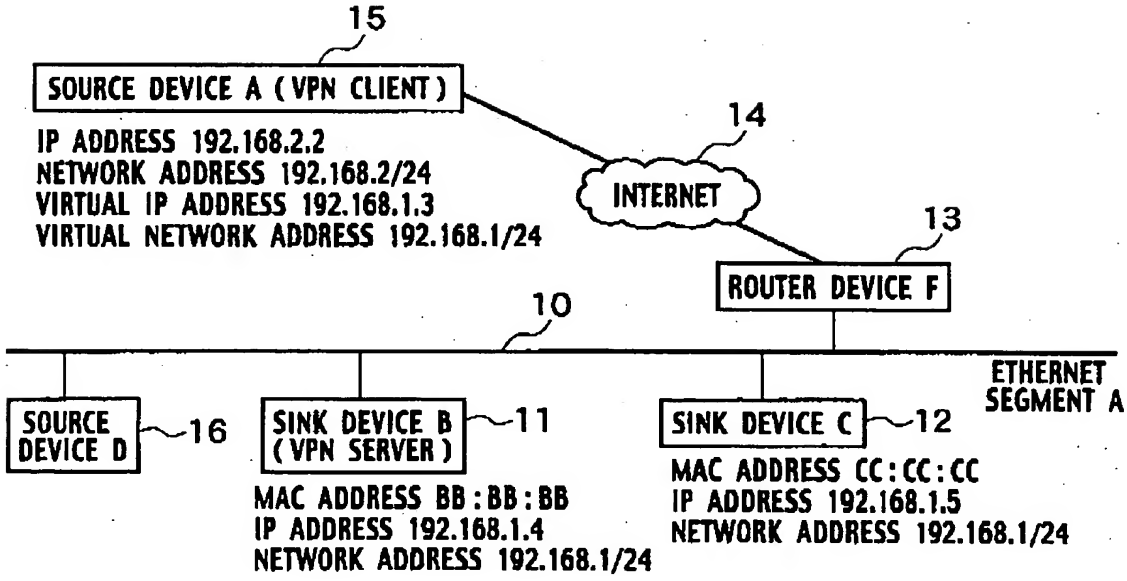
15
SOURCE DEVICE A (VPN CLIENT)
IP ADDRESS 192.168.2.2
NETWORK ADDRESS 192.168.2/24
VIRTUAL IP ADDRESS 192.168.1.3
VIRTUAL NETWORK ADDRESS 192.168.1/24
14
INTERNET
13
ROUTER DEVICE F
10
ETHERNET SEGMENT A
SOURCE DEVICE D
16
SINK DEVICE B (VPN SERVER)
11
MAC ADDRESS BB:BB:BB
IP ADDRESS 192.168.1.4
NETWORK ADDRESS 192.168.1/24
SINK DEVICE C
12
MAC ADDRESS CC:CC:CC
IP ADDRESS 192.168.1.5
NETWORK ADDRESS 192.168.1/24

FIG. 2

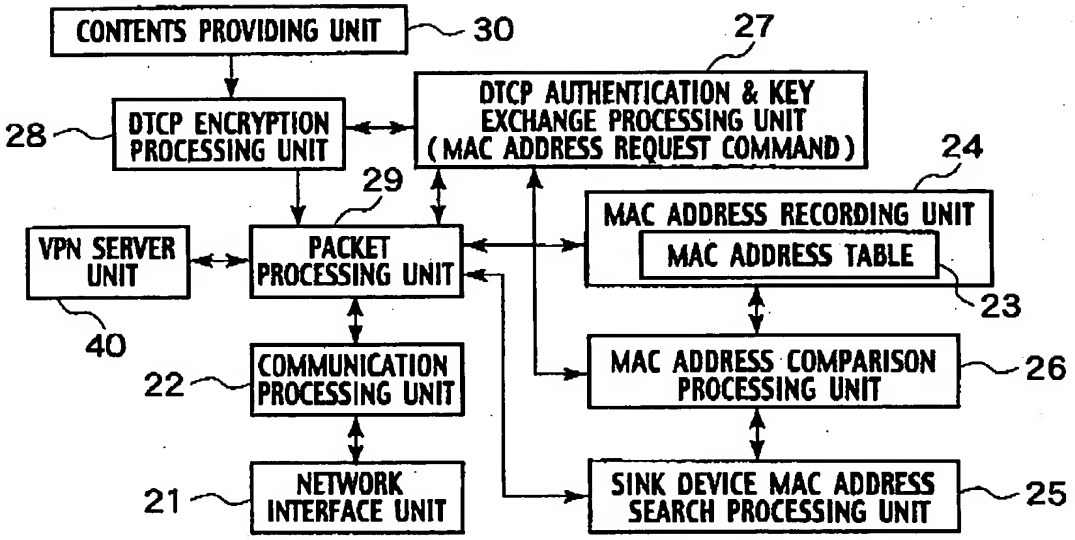
CONTENTS PROVIDING UNIT
30
27
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT (MAC ADDRESS REQUEST COMMAND)
28
DTCP ENCRYPTION PROCESSING UNIT
24
MAC ADDRESS RECORDING UNIT
MAC ADDRESS TABLE
23
29
VPN SERVER UNIT
40
PACKET PROCESSING UNIT
22
COMMUNICATION PROCESSING UNIT
MAC ADDRESS COMPARISON PROCESSING UNIT
26
21
NETWORK INTERFACE UNIT
SINK DEVICE MAC ADDRESS SEARCH PROCESSING UNIT
25

FIG. 3

MAC ADDRESS TABLE

	IP ADDRESS	MAC ADDRESS	DEVICE ID
SINK DEVICE B	192.168.1.3	BB:BB:BB	B1
SINK DEVICE C	192.168.1.5	CC:CC:CC	C1
SINK DEVICE X	192.168.78	XX:XX:XX	X1
.....			

FIG. 4

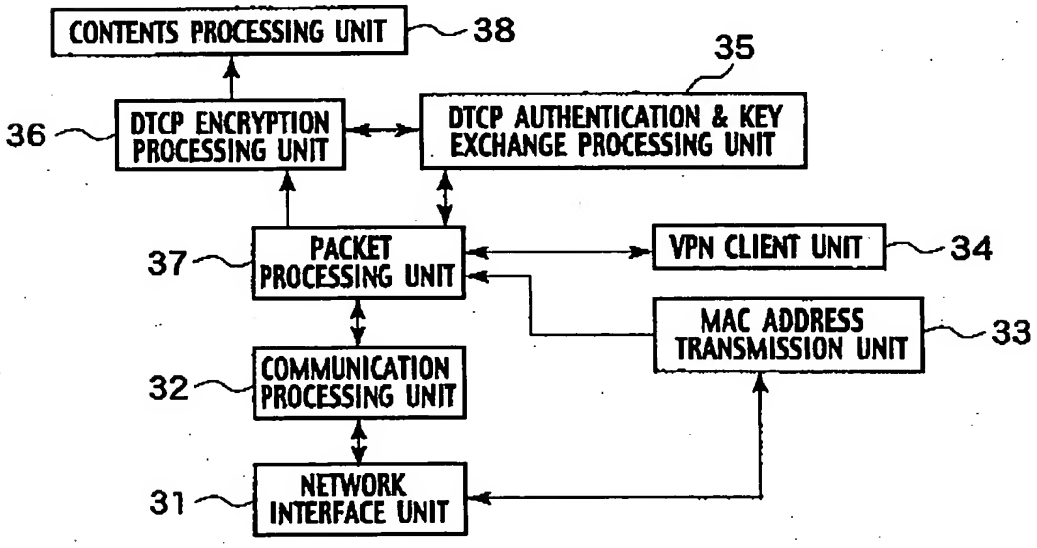

FIG. 5

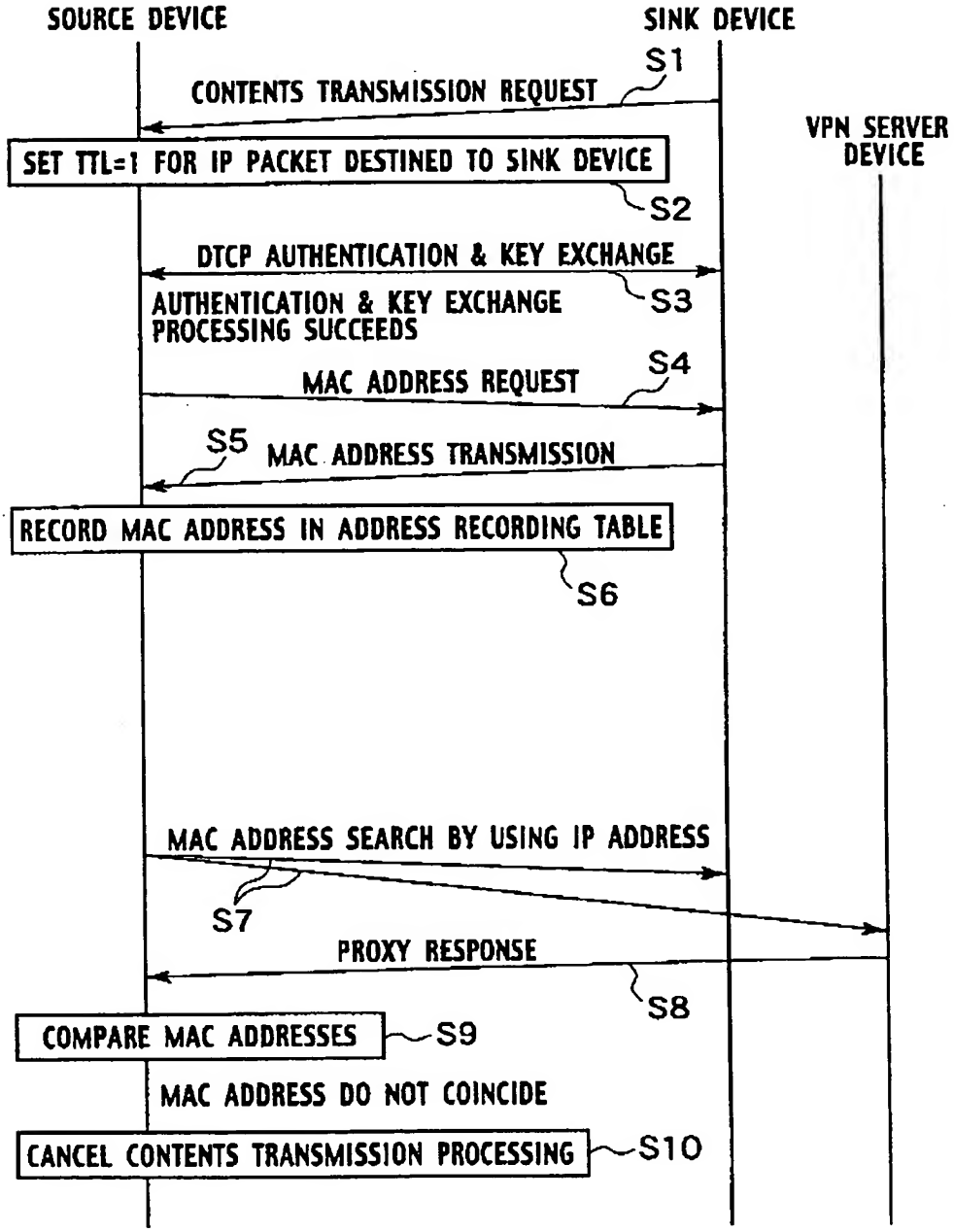
SOURCE DEVICE
SINK DEVICE
VPN SERVER DEVICE
S1
CONTENTS TRANSMISSION REQUEST
SET TTL=1 FOR IP PACKET DESTINED TO SINK DEVICE
S2
DTCP AUTHENTICATION & KEY EXCHANGE
S3
AUTHENTICATION & KEY EXCHANGE PROCESSING SUCCEEDS
S4
MAC ADDRESS REQUEST
S5
MAC ADDRESS TRANSMISSION
RECORD MAC ADDRESS IN ADDRESS RECORDING TABLE
S6
MAC ADDRESS SEARCH BY USING IP ADDRESS
S7
PROXY RESPONSE
S8
COMPARE MAC ADDRESSES
S9
MAC ADDRESS DO NOT COINCIDE
CANCEL CONTENTS TRANSMISSION PROCESSING
S10

FIG. 6

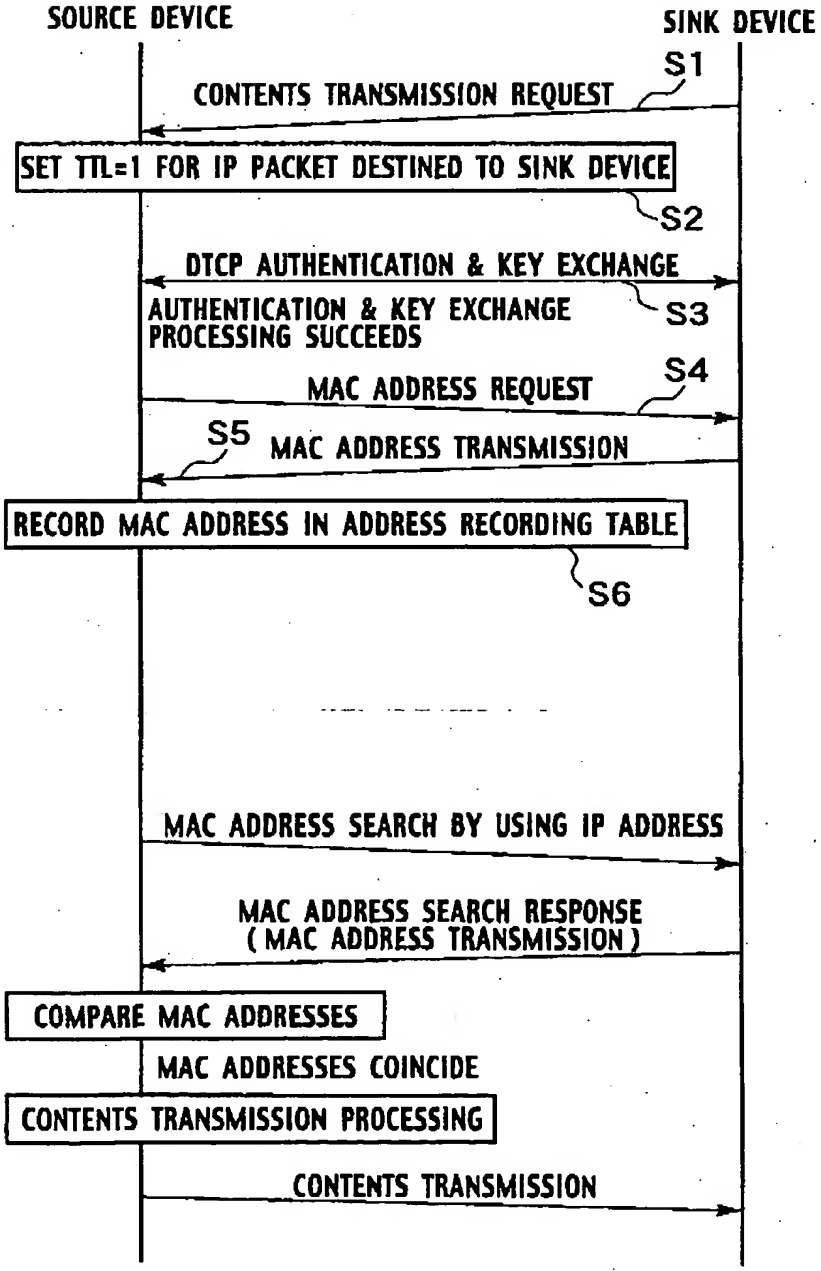
SOURCE DEVICE
SINK DEVICE
S1
CONTENTS TRANSMISSION REQUEST
SET TTL=1 FOR IP PACKET DESTINED TO SINK DEVICE
S2
DTCP AUTHENTICATION & KEY EXCHANGE
S3
AUTHENTICATION & KEY EXCHANGE PROCESSING SUCCEEDS
S4
MAC ADDRESS REQUEST
S5
MAC ADDRESS TRANSMISSION
RECORD MAC ADDRESS IN ADDRESS RECORDING TABLE
S6
MAC ADDRESS SEARCH BY USING IP ADDRESS
MAC ADDRESS SEARCH RESPONSE (MAC ADDRESS TRANSMISSION)
COMPARE MAC ADDRESSES
MAC ADDRESSES COINCIDE
CONTENTS TRANSMISSION PROCESSING
CONTENTS TRANSMISSION

FIG. 7

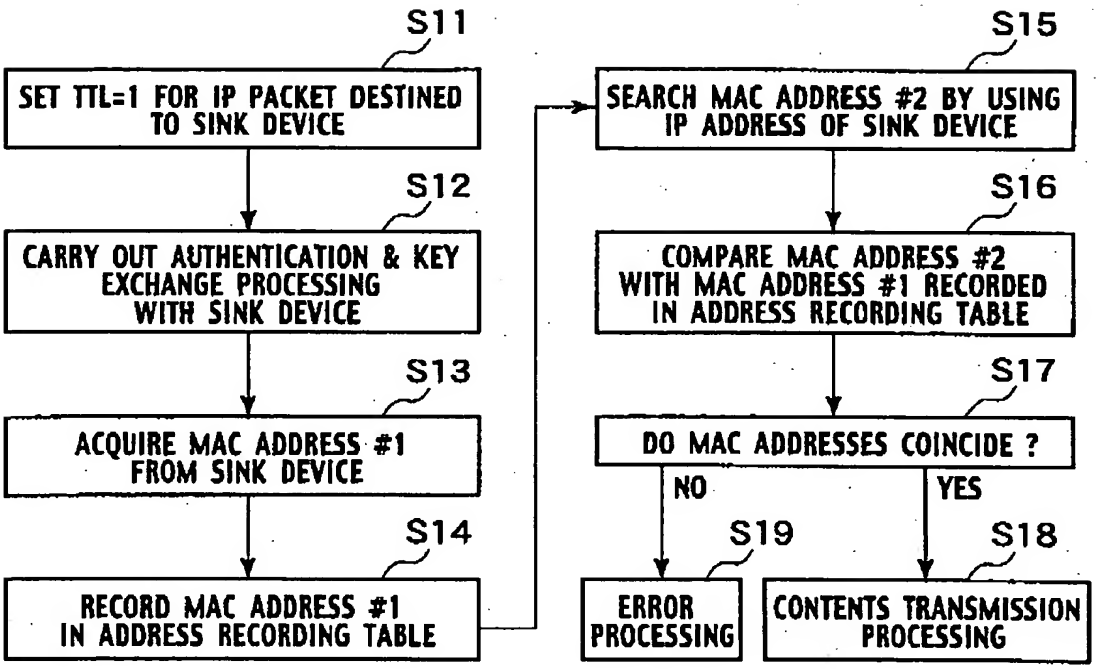
S11
SET TTL=1 FOR IP PACKET DESTINED TO SINK DEVICE
S12
CARRY OUT AUTHENTICATION & KEY EXCHANGE PROCESSING WITH SINK DEVICE
S13
ACQUIRE MAC ADDRESS #1 FROM SINK DEVICE
S14
RECORD MAC ADDRESS #1 IN ADDRESS RECORDING TABLE
S15
SEARCH MAC ADDRESS #2 BY USING IP ADDRESS OF SINK DEVICE
S16
COMPARE MAC ADDRESS #2 WITH MAC ADDRESS #1 RECORDED IN ADDRESS RECORDING TABLE
S17
DO MAC ADDRESSES COINCIDE ?
NO
YES
S19
ERROR PROCESSING
S18
CONTENTS TRANSMISSION PROCESSING

FIG. 8

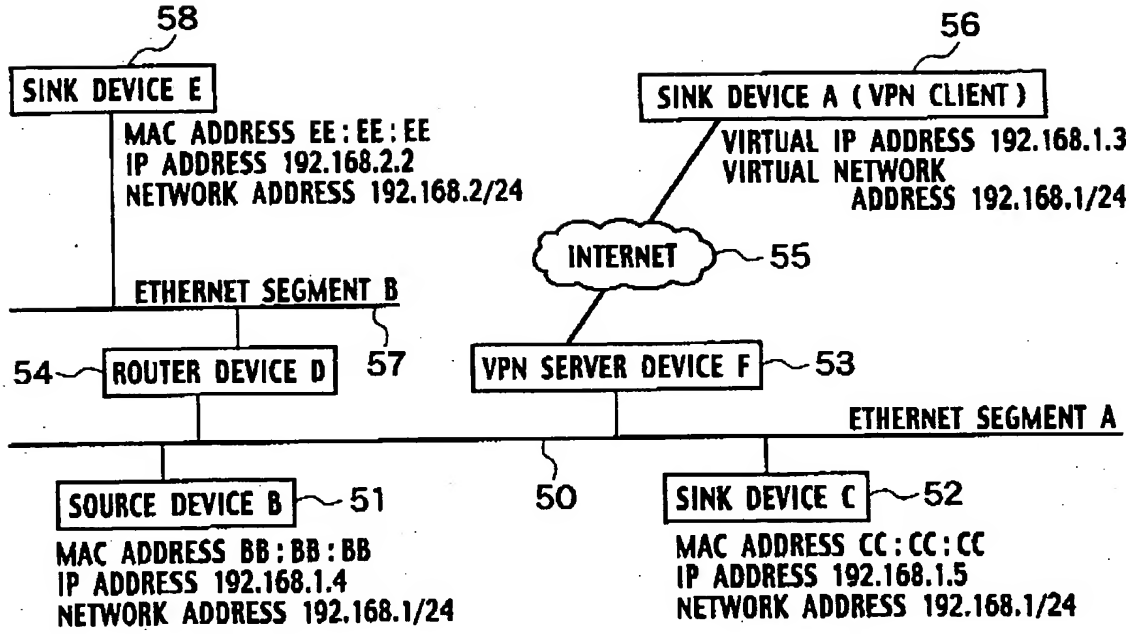
58
SINK DEVICE E
MAC ADDRESS EE:EE:EE
IP ADDRESS 192.168.2.2
NETWORK ADDRESS 192.168.2/24
56
SINK DEVICE A (VPN CLIENT)
VIRTUAL IP ADDRESS 192.168.1.3
VIRTUAL NETWORK
ADDRESS 192.168.1/24
INTERNET
55
ETHERNET SEGMENT B
57
54
ROUTER DEVICE D
VPN SERVER DEVICE F
53
ETHERNET SEGMENT A
50
SOURCE DEVICE B
51
MAC ADDRESS BB:BB:BB
IP ADDRESS 192.168.1.4
NETWORK ADDRESS 192.168.1/24
SINK DEVICE C
52
MAC ADDRESS CC:CC:CC
IP ADDRESS 192.168.1.5
NETWORK ADDRESS 192.168.1/24

FIG. 9

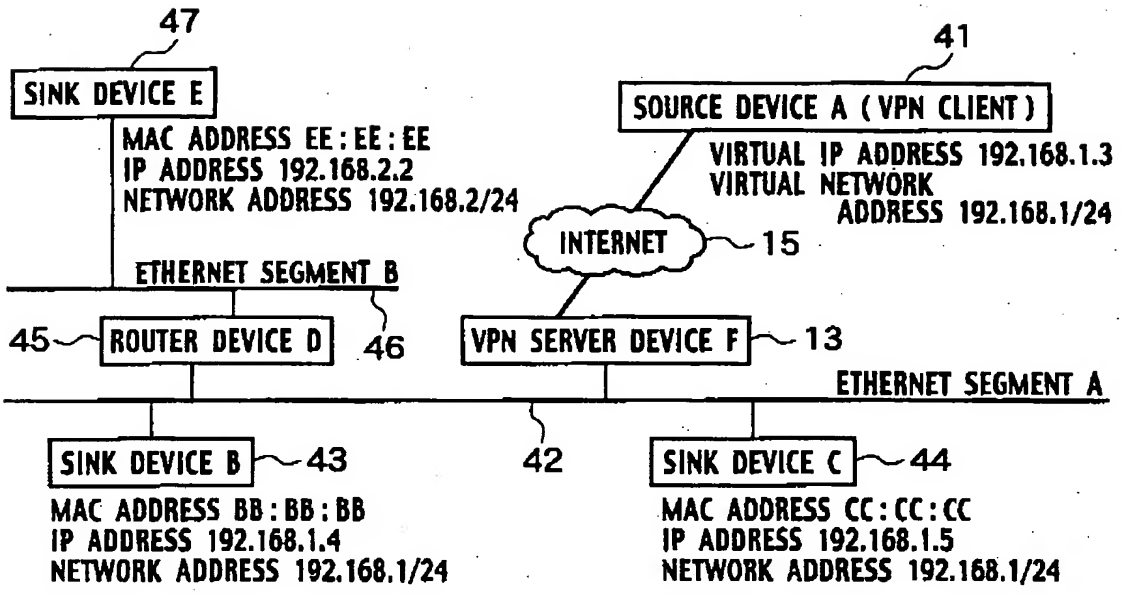
47
SINK DEVICE E
MAC ADDRESS EE:EE:EE
IP ADDRESS 192.168.2.2
NETWORK ADDRESS 192.168.2/24
41
SOURCE DEVICE A (VPN CLIENT)
VIRTUAL IP ADDRESS 192.168.1.3
VIRTUAL NETWORK ADDRESS 192.168.1/24
INTERNET
15
ETHERNET SEGMENT B
45
ROUTER DEVICE D
46
VPN SERVER DEVICE F
13
ETHERNET SEGMENT A
42
SINK DEVICE B
43
MAC ADDRESS BB:BB:BB
IP ADDRESS 192.168.1.4
NETWORK ADDRESS 192.168.1/24
SINK DEVICE C
44
MAC ADDRESS CC:CC:CC
IP ADDRESS 192.168.1.5
NETWORK ADDRESS 192.168.1/24

FIG. 10

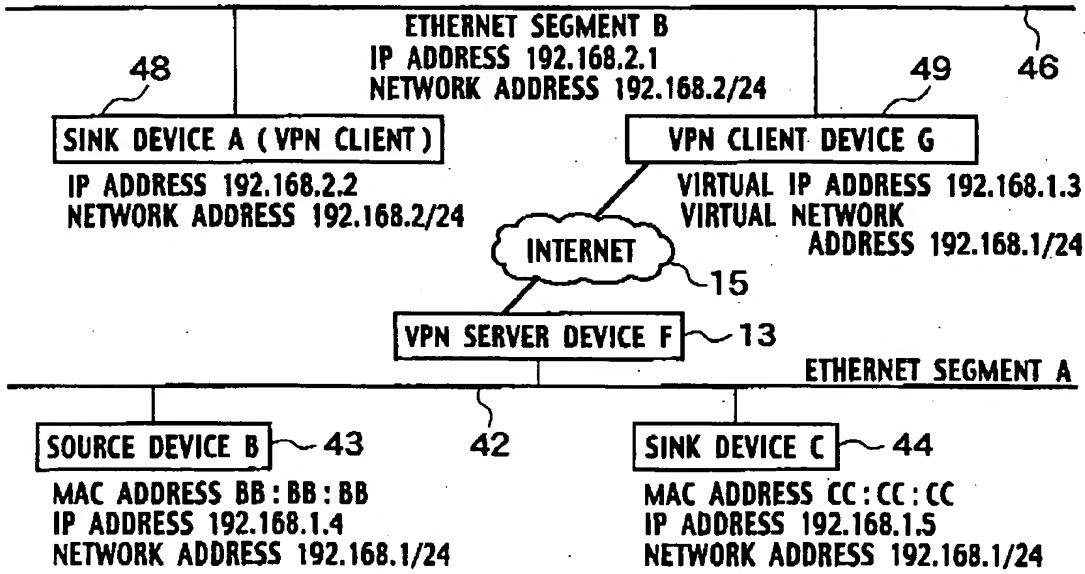
ETHERNET SEGMENT B
IP ADDRESS 192.168.2.1
NETWORK ADDRESS 192.168.2/24
46
48
SINK DEVICE A (VPN CLIENT)
IP ADDRESS 192.168.2.2
NETWORK ADDRESS 192.168.2/24
49
VPN CLIENT DEVICE G
VIRTUAL IP ADDRESS 192.168.1.3
VIRTUAL NETWORK ADDRESS 192.168.1/24
INTERNET
15
VPN SERVER DEVICE F
13
ETHERNET SEGMENT A
42
SOURCE DEVICE B
43
MAC ADDRESS BB:BB:BB
IP ADDRESS 192.168.1.4
NETWORK ADDRESS 192.168.1/24
SINK DEVICE C
44
MAC ADDRESS CC:CC:CC
IP ADDRESS 192.168.1.5
NETWORK ADDRESS 192.168.1/24

FIG. 11

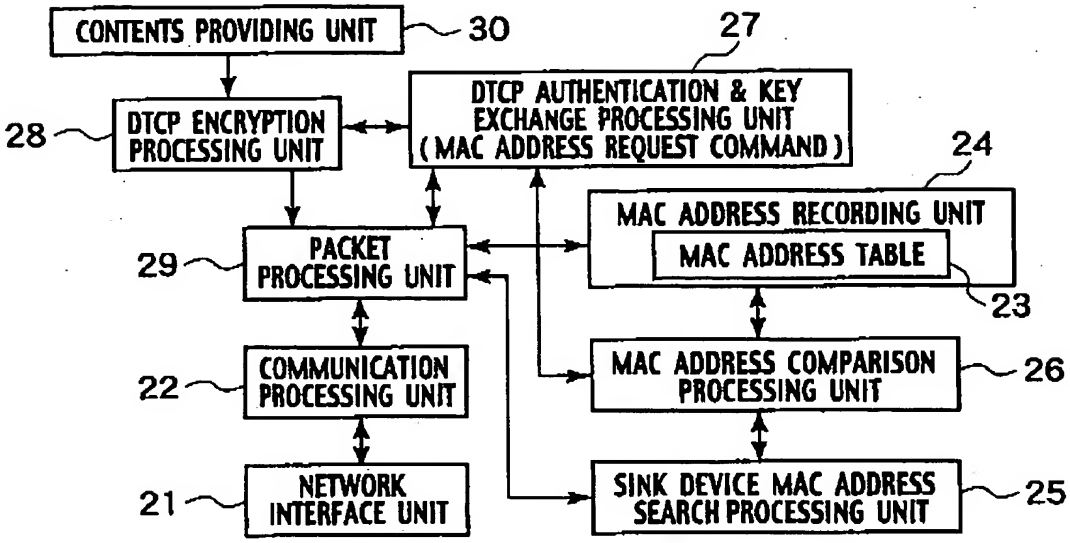
CONTENTS PROVIDING UNIT
30
27
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT (MAC ADDRESS REQUEST COMMAND)
28
DTCP ENCRYPTION PROCESSING UNIT
24
MAC ADDRESS RECORDING UNIT
MAC ADDRESS TABLE
23
29
PACKET PROCESSING UNIT
22
COMMUNICATION PROCESSING UNIT
MAC ADDRESS COMPARISON PROCESSING UNIT
26
21
NETWORK INTERFACE UNIT
SINK DEVICE MAC ADDRESS SEARCH PROCESSING UNIT
25

FIG. 12

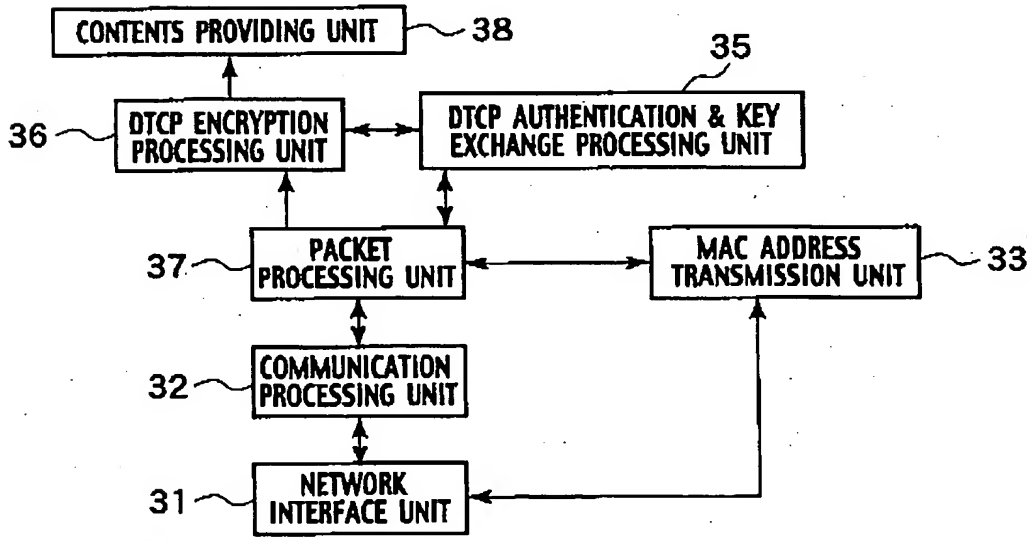
CONTENTS PROVIDING UNIT
38
35
36
DTCP ENCRYPTION PROCESSING UNIT
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT
37
PACKET PROCESSING UNIT
MAC ADDRESS TRANSMISSION UNIT
33
32
COMMUNICATION PROCESSING UNIT
31
NETWORK INTERFACE UNIT

FIG. 13

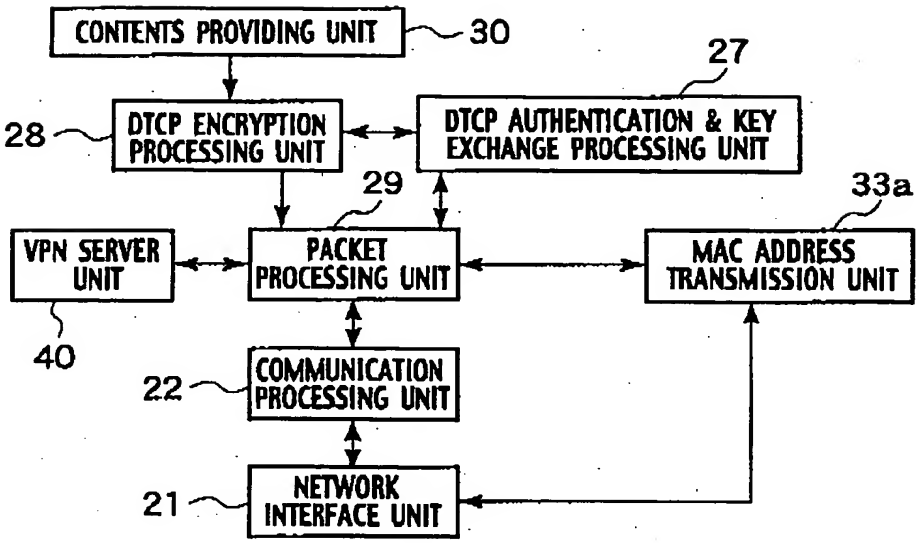
CONTENTS PROVIDING UNIT
30
27
28
DTCP ENCRYPTION PROCESSING UNIT
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT
29
33a
VPN SERVER UNIT
PACKET PROCESSING UNIT
MAC ADDRESS TRANSMISSION UNIT
40
22
COMMUNICATION PROCESSING UNIT
21
NETWORK INTERFACE UNIT

FIG. 14

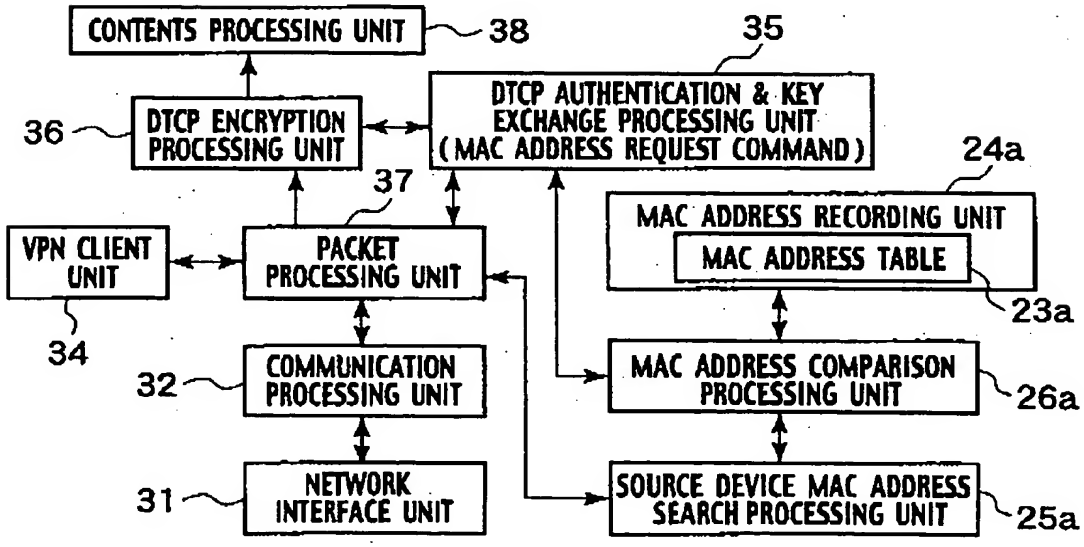
CONTENTS PROCESSING UNIT
38
35
36
DTCP ENCRYPTION PROCESSING UNIT
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT (MAC ADDRESS REQUEST COMMAND)
24a
37
MAC ADDRESS RECORDING UNIT
MAC ADDRESS TABLE
23a
VPN CLIENT UNIT
PACKET PROCESSING UNIT
34
32
COMMUNICATION PROCESSING UNIT
MAC ADDRESS COMPARISON PROCESSING UNIT
26a
31
NETWORK INTERFACE UNIT
SOURCE DEVICE MAC ADDRESS SEARCH PROCESSING UNIT
25a

FIG. 15

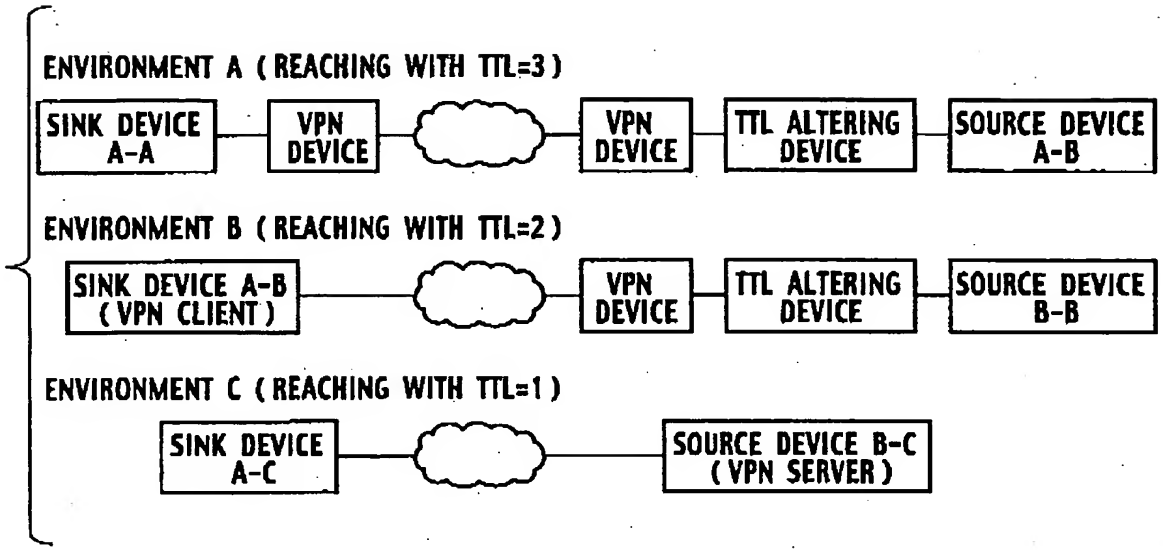
ENVIRONMENT A (REACHING WITH TTL=3)
SINK DEVICE A-A
VPN DEVICE
VPN DEVICE
TTL ALTERING DEVICE
SOURCE DEVICE A-B
ENVIRONMENT B (REACHING WITH TTL=2)
SINK DEVICE A-B (VPN CLIENT)
VPN DEVICE
TTL ALTERING DEVICE
SOURCE DEVICE B-B
ENVIRONMENT C (REACHING WITH TTL=1)
SINK DEVICE A-C
SOURCE DEVICE B-C (VPN SERVER)

FIG. 16

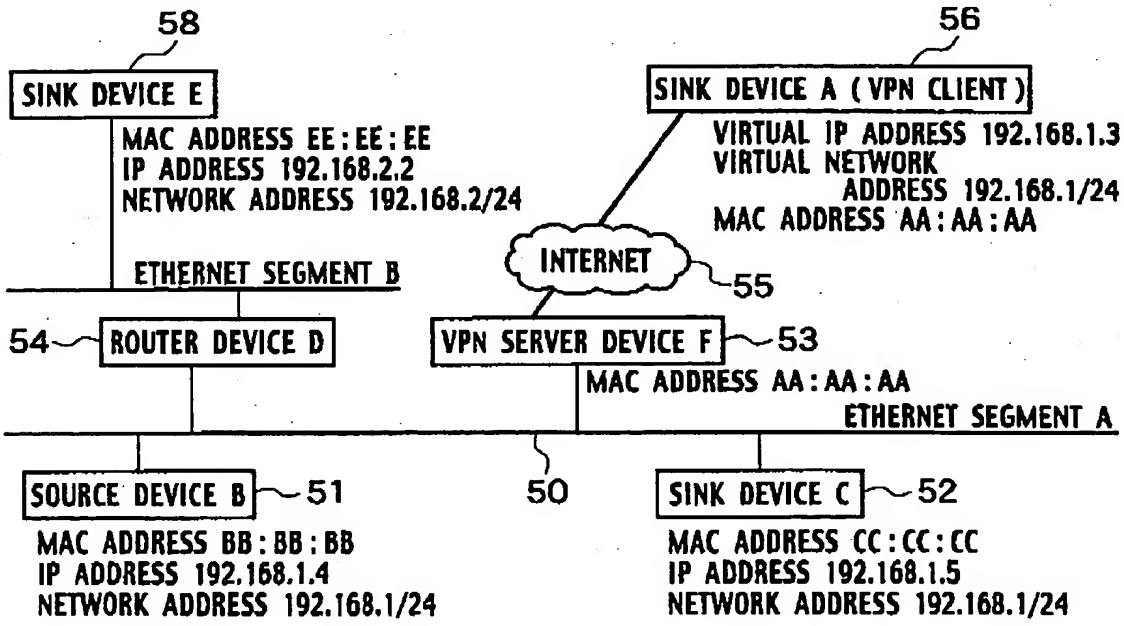
58
SINK DEVICE E
MAC ADDRESS EE : EE : EE
IP ADDRESS 192.168.2.2
NETWORK ADDRESS 192.168.2/24
ETHERNET SEGMENT B
56
SINK DEVICE A (VPN CLIENT)
VIRTUAL IP ADDRESS 192.168.1.3
VIRTUAL NETWORK ADDRESS 192.168.1/24
MAC ADDRESS AA : AA : AA
INTERNET
55
54
ROUTER DEVICE D
VPN SERVER DEVICE F
53
MAC ADDRESS AA : AA : AA
ETHERNET SEGMENT A
50
SOURCE DEVICE B
51
MAC ADDRESS BB : BB : BB
IP ADDRESS 192.168.1.4
NETWORK ADDRESS 192.168.1/24
SINK DEVICE C
52
MAC ADDRESS CC : CC : CC
IP ADDRESS 192.168.1.5
NETWORK ADDRESS 192.168.1/24

FIG. 17

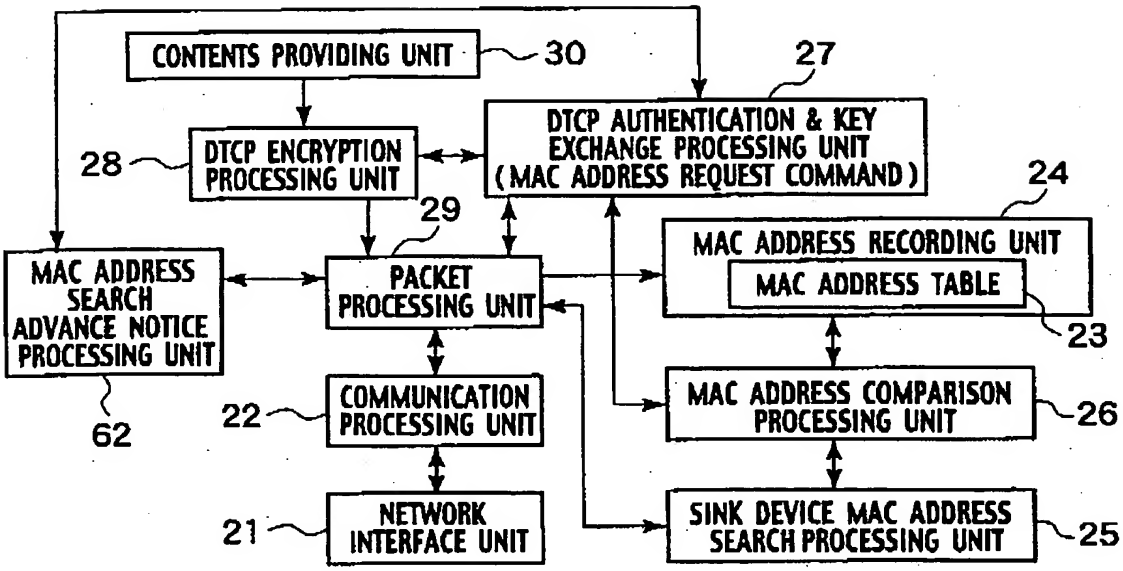
CONTENTS PROVIDING UNIT
30
27
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT (MAC ADDRESS REQUEST COMMAND)
28
DTCP ENCRYPTION PROCESSING UNIT
29
24
MAC ADDRESS RECORDING UNIT
MAC ADDRESS TABLE
23
MAC ADDRESS SEARCH ADVANCE NOTICE PROCESSING UNIT
62
PACKET PROCESSING UNIT
22
COMMUNICATION PROCESSING UNIT
MAC ADDRESS COMPARISON PROCESSING UNIT
26
21
NETWORK INTERFACE UNIT
SINK DEVICE MAC ADDRESS SEARCH PROCESSING UNIT
25

FIG. 18

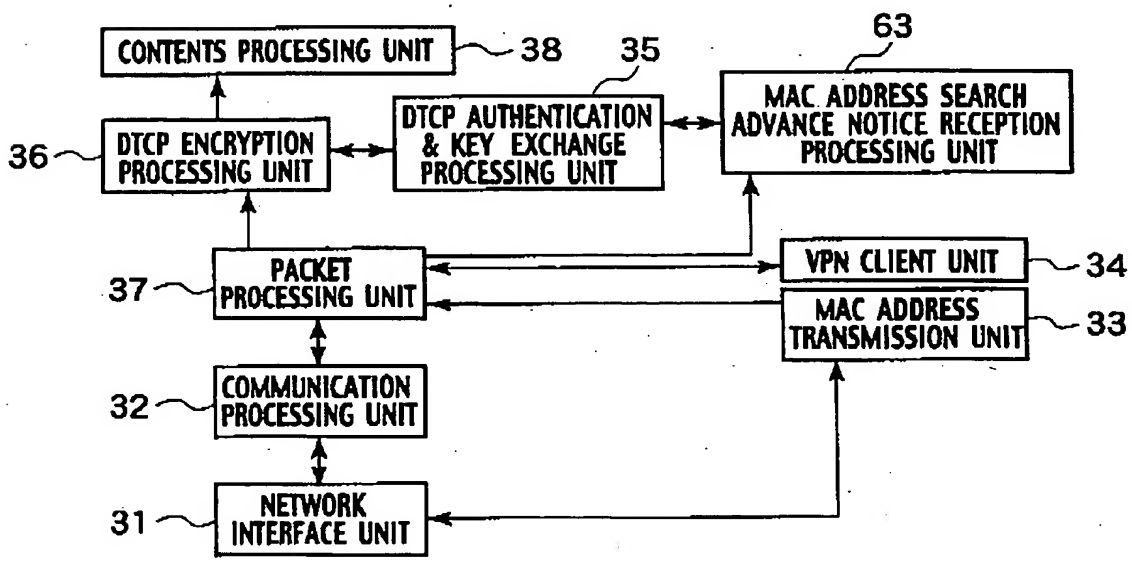
CONTENTS PROCESSING UNIT
38
35
63
MAC ADDRESS SEARCH ADVANCE NOTICE RECEPTION PROCESSING UNIT
36
DTCP ENCRYPTION PROCESSING UNIT
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT
VPN CLIENT UNIT
34
37
PACKET PROCESSING UNIT
MAC ADDRESS TRANSMISSION UNIT
33
32
COMMUNICATION PROCESSING UNIT
31
NETWORK INTERFACE UNIT

FIG. 19

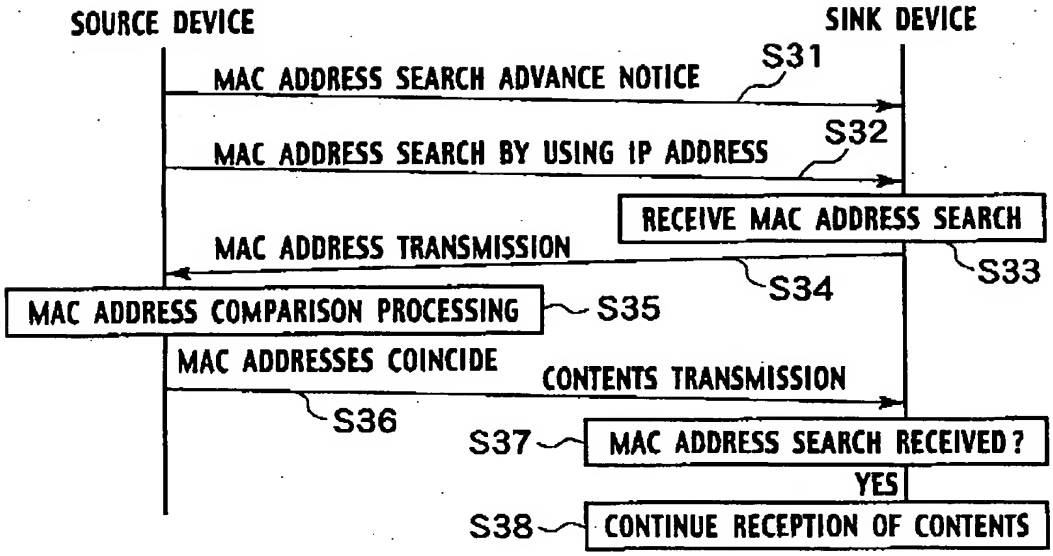
SOURCE DEVICE
SINK DEVICE
MAC ADDRESS SEARCH ADVANCE NOTICE
S31
MAC ADDRESS SEARCH BY USING IP ADDRESS
S32
RECEIVE MAC ADDRESS SEARCH
S33
MAC ADDRESS TRANSMISSION
S34
MAC ADDRESS COMPARISON PROCESSING
S35
MAC ADDRESSES COINCIDE
CONTENTS TRANSMISSION
S36
S37
MAC ADDRESS SEARCH RECEIVED?
YES
S38
CONTINUE RECEPTION OF CONTENTS

FIG. 20

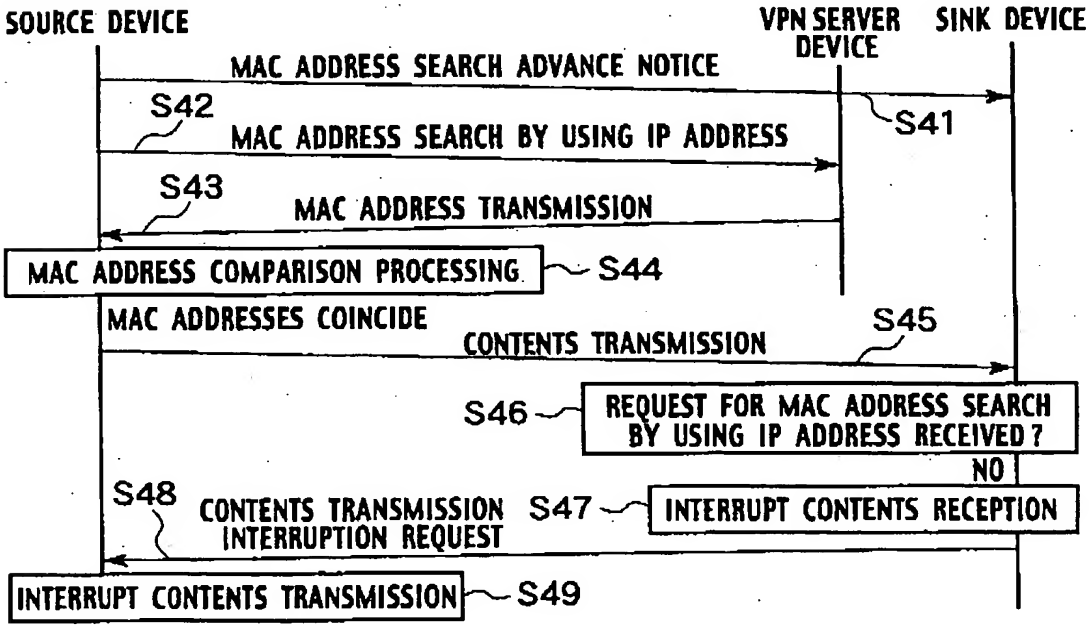
SOURCE DEVICE
VPN SERVER DEVICE
SINK DEVICE
MAC ADDRESS SEARCH ADVANCE NOTICE
S41
S42
MAC ADDRESS SEARCH BY USING IP ADDRESS
S43
MAC ADDRESS TRANSMISSION
MAC ADDRESS COMPARISON PROCESSING
S44
MAC ADDRESSES COINCIDE
CONTENTS TRANSMISSION
S45
S46
REQUEST FOR MAC ADDRESS SEARCH BY USING IP ADDRESS RECEIVED?
NO
S48
CONTENTS TRANSMISSION INTERRUPTION REQUEST
S47
INTERRUPT CONTENTS RECEPTION
INTERRUPT CONTENTS TRANSMISSION
S49

FIG. 21

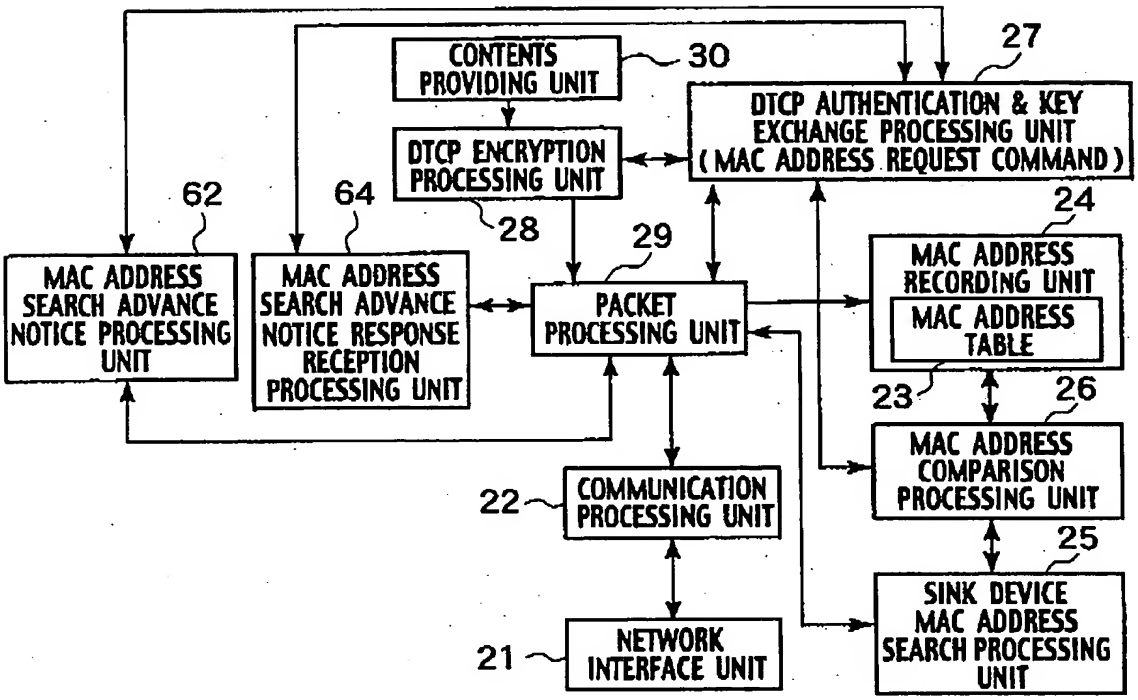
CONTENTS PROVIDING UNIT
30
27
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT (MAC ADDRESS REQUEST COMMAND)
DTCP ENCRYPTION PROCESSING UNIT
28
62
64
24
MAC ADDRESS SEARCH ADVANCE NOTICE PROCESSING UNIT
MAC ADDRESS SEARCH ADVANCE NOTICE RESPONSE RECEPTION PROCESSING UNIT
29
PACKET PROCESSING UNIT
MAC ADDRESS RECORDING UNIT
MAC ADDRESS TABLE
23
26
MAC ADDRESS COMPARISON PROCESSING UNIT
22
COMMUNICATION PROCESSING UNIT
25
SINK DEVICE MAC ADDRESS SEARCH PROCESSING UNIT
21
NETWORK INTERFACE UNIT

FIG. 22

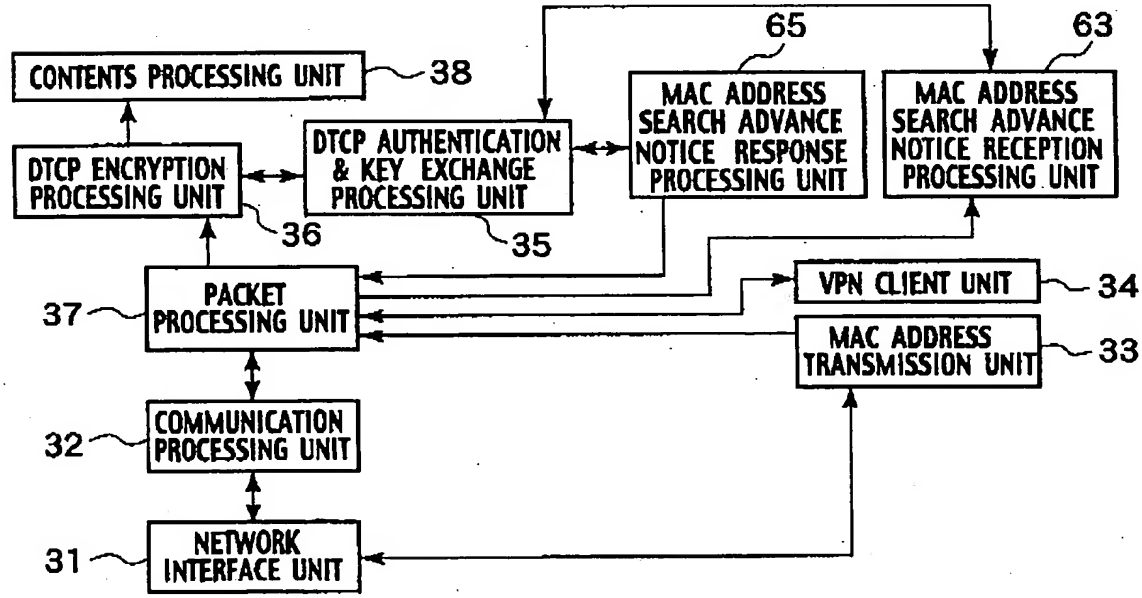
65
63
CONTENTS PROCESSING UNIT
38
MAC ADDRESS SEARCH ADVANCE NOTICE RESPONSE PROCESSING UNIT
MAC ADDRESS SEARCH ADVANCE NOTICE RECEPTION PROCESSING UNIT
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT
DTCP ENCRYPTION PROCESSING UNIT
36
35
VPN CLIENT UNIT
34
37
PACKET PROCESSING UNIT
MAC ADDRESS TRANSMISSION UNIT
33
32
COMMUNICATION PROCESSING UNIT
31
NETWORK INTERFACE UNIT

FIG. 23

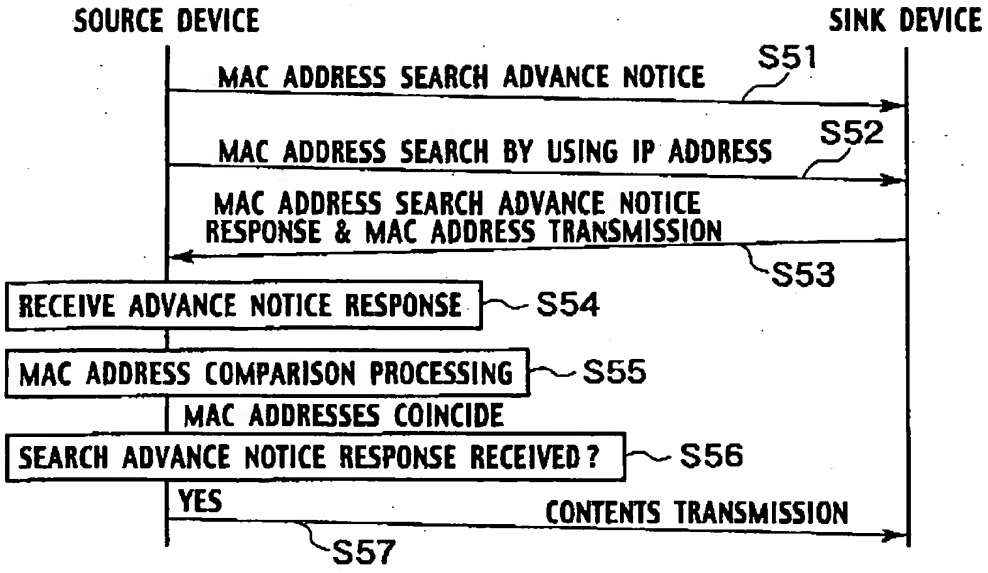
SOURCE DEVICE
SINK DEVICE
MAC ADDRESS SEARCH ADVANCE NOTICE
S51
MAC ADDRESS SEARCH BY USING IP ADDRESS
S52
MAC ADDRESS SEARCH ADVANCE NOTICE RESPONSE & MAC ADDRESS TRANSMISSION
S53
RECEIVE ADVANCE NOTICE RESPONSE
S54
MAC ADDRESS COMPARISON PROCESSING
S55
MAC ADDRESSES COINCIDE
SEARCH ADVANCE NOTICE RESPONSE RECEIVED?
S56
YES
CONTENTS TRANSMISSION
S57

FIG. 24

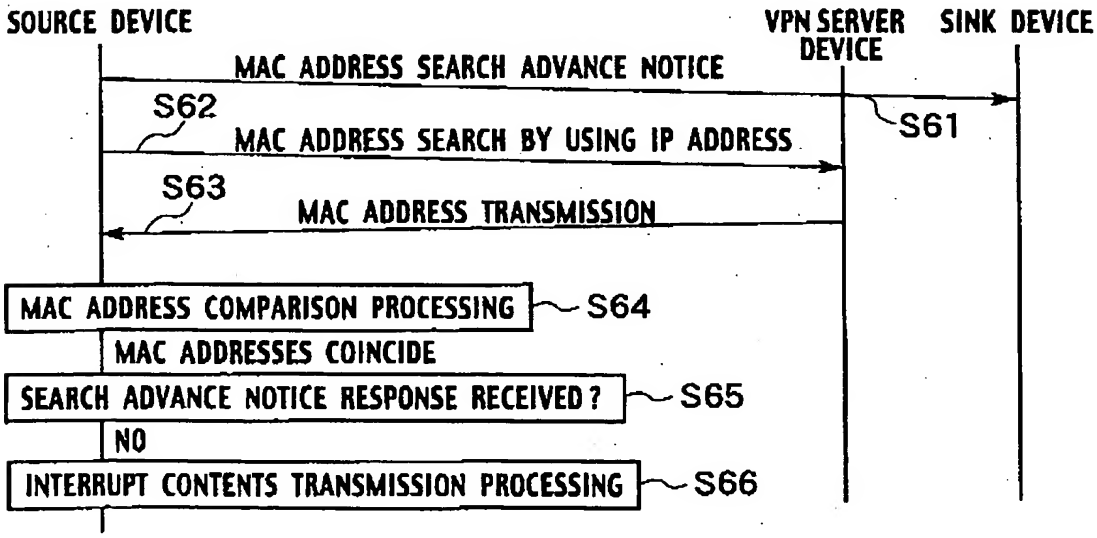
SOURCE DEVICE
VPN SERVER DEVICE
SINK DEVICE
MAC ADDRESS SEARCH ADVANCE NOTICE
S61
S62
MAC ADDRESS SEARCH BY USING IP ADDRESS
S63
MAC ADDRESS TRANSMISSION
MAC ADDRESS COMPARISON PROCESSING
S64
MAC ADDRESSES COINCIDE
SEARCH ADVANCE NOTICE RESPONSE RECEIVED?
S65
NO
INTERRUPT CONTENTS TRANSMISSION PROCESSING
S66

FIG. 25

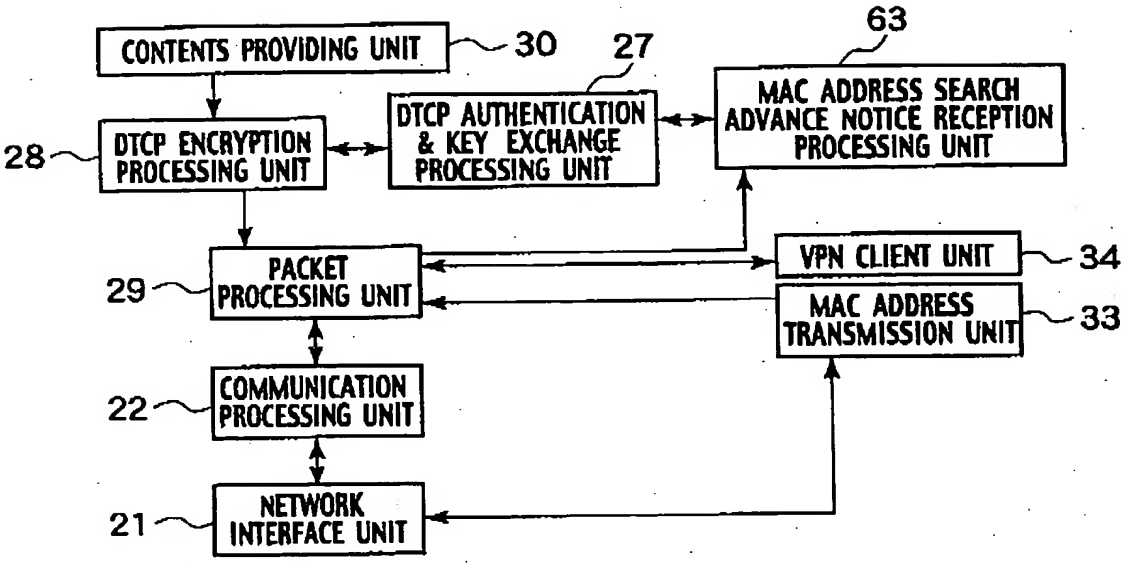
CONTENTS PROVIDING UNIT
30
27
63
MAC ADDRESS SEARCH ADVANCE NOTICE RECEPTION PROCESSING UNIT
28
DTCP ENCRYPTION PROCESSING UNIT
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT
VPN CLIENT UNIT
34
29
PACKET PROCESSING UNIT
MAC ADDRESS TRANSMISSION UNIT
33
22
COMMUNICATION PROCESSING UNIT
21
NETWORK INTERFACE UNIT

FIG. 26

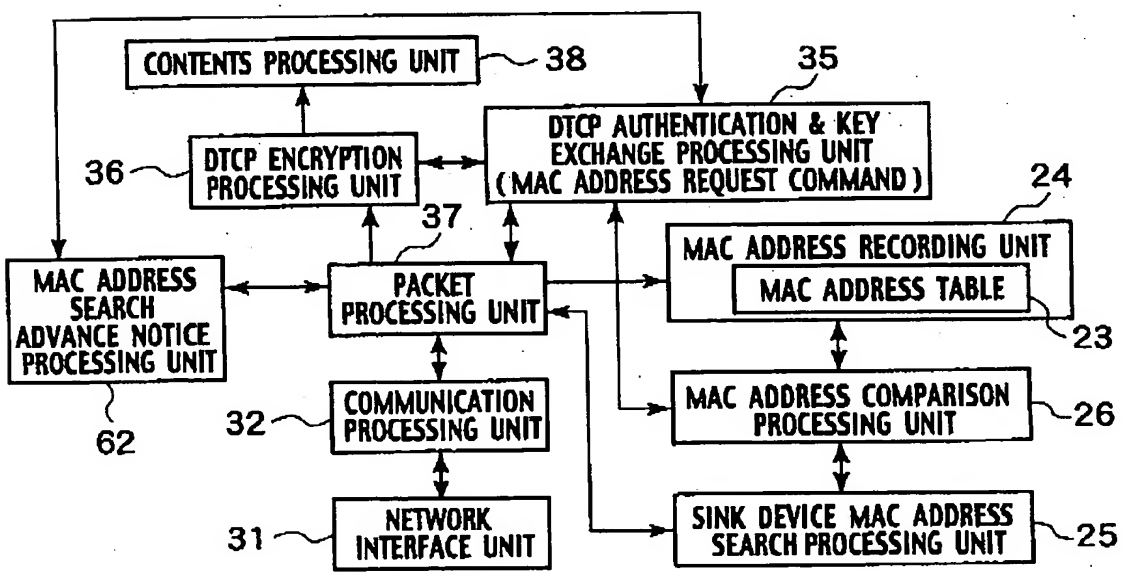
CONTENTS PROCESSING UNIT
38
35
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT (MAC ADDRESS REQUEST COMMAND)
36
DTCP ENCRYPTION PROCESSING UNIT
24
37
MAC ADDRESS RECORDING UNIT
MAC ADDRESS TABLE
MAC ADDRESS SEARCH ADVANCE NOTICE PROCESSING UNIT
PACKET PROCESSING UNIT
23
MAC ADDRESS COMPARISON PROCESSING UNIT
26
32
COMMUNICATION PROCESSING UNIT
62
31
NETWORK INTERFACE UNIT
SINK DEVICE MAC ADDRESS SEARCH PROCESSING UNIT
25

FIG. 27

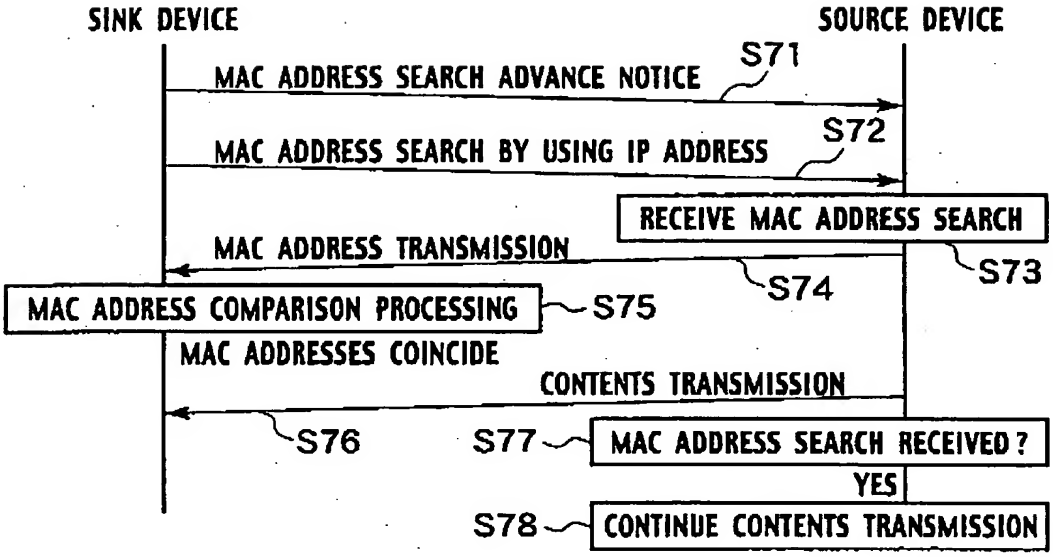
SINK DEVICE
SOURCE DEVICE
MAC ADDRESS SEARCH ADVANCE NOTICE
S71
MAC ADDRESS SEARCH BY USING IP ADDRESS
S72
RECEIVE MAC ADDRESS SEARCH
S73
MAC ADDRESS TRANSMISSION
S74
MAC ADDRESS COMPARISON PROCESSING
S75
MAC ADDRESSES COINCIDE
CONTENTS TRANSMISSION
S76
S77
MAC ADDRESS SEARCH RECEIVED?
YES
S78
CONTINUE CONTENTS TRANSMISSION

FIG. 28

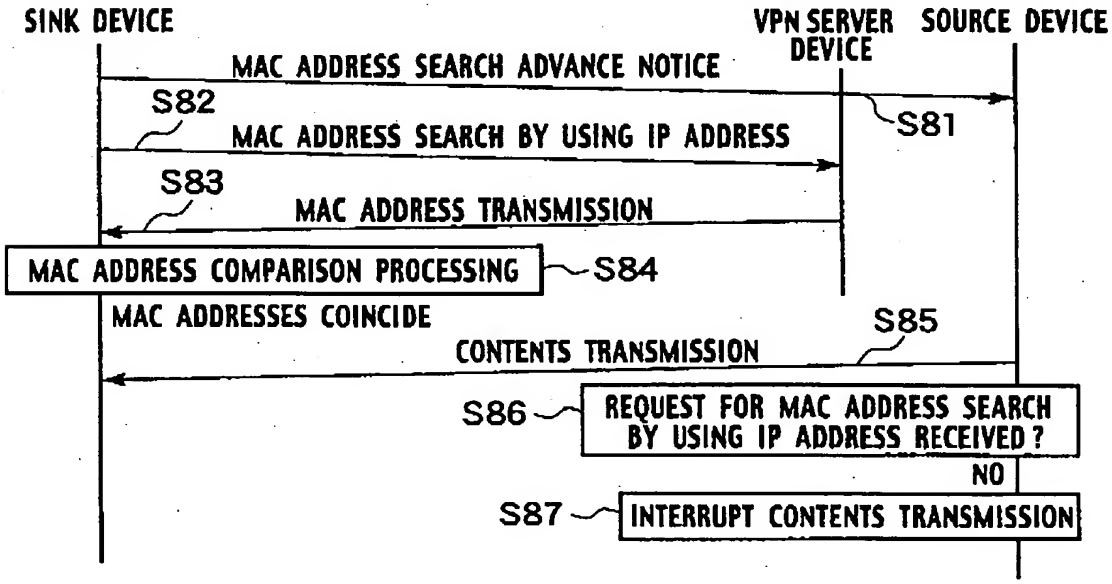
SINK DEVICE
VPN SERVER DEVICE
SOURCE DEVICE
MAC ADDRESS SEARCH ADVANCE NOTICE
S81
S82
MAC ADDRESS SEARCH BY USING IP ADDRESS
S83
MAC ADDRESS TRANSMISSION
MAC ADDRESS COMPARISON PROCESSING
S84
MAC ADDRESSES COINCIDE
S85
CONTENTS TRANSMISSION
S86
REQUEST FOR MAC ADDRESS SEARCH BY USING IP ADDRESS RECEIVED?
NO
S87
INTERRUPT CONTENTS TRANSMISSION

FIG. 29

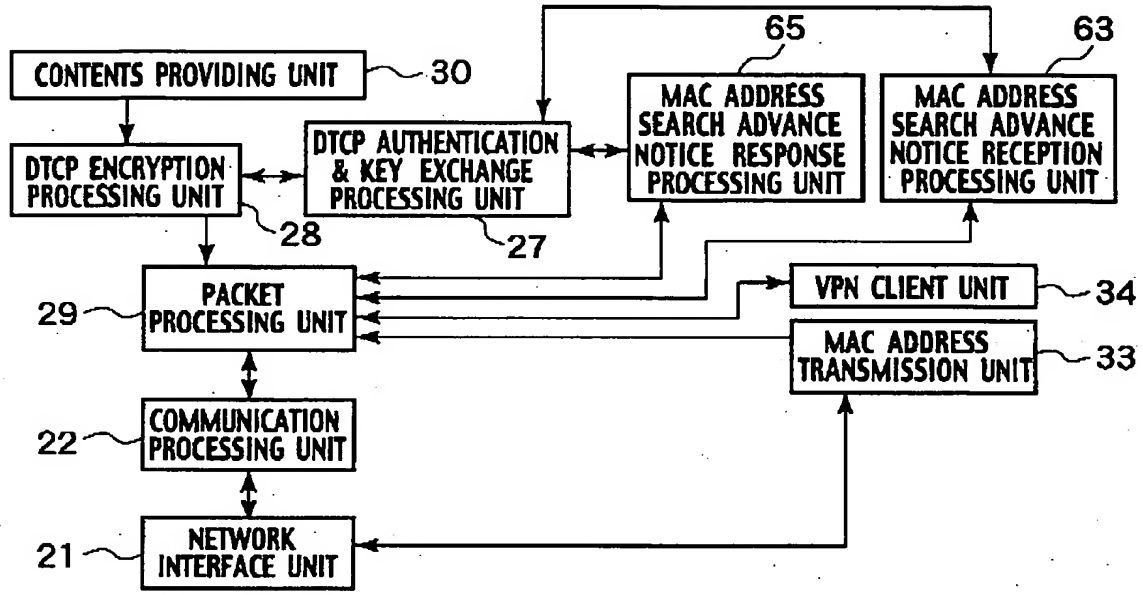
CONTENTS PROVIDING UNIT
30
65
63
MAC ADDRESS SEARCH ADVANCE NOTICE RESPONSE PROCESSING UNIT
MAC ADDRESS SEARCH ADVANCE NOTICE RECEPTION PROCESSING UNIT
DTCP ENCRYPTION PROCESSING UNIT
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT
28
27
29
PACKET PROCESSING UNIT
VPN CLIENT UNIT
34
MAC ADDRESS TRANSMISSION UNIT
33
22
COMMUNICATION PROCESSING UNIT
21
NETWORK INTERFACE UNIT

FIG. 30

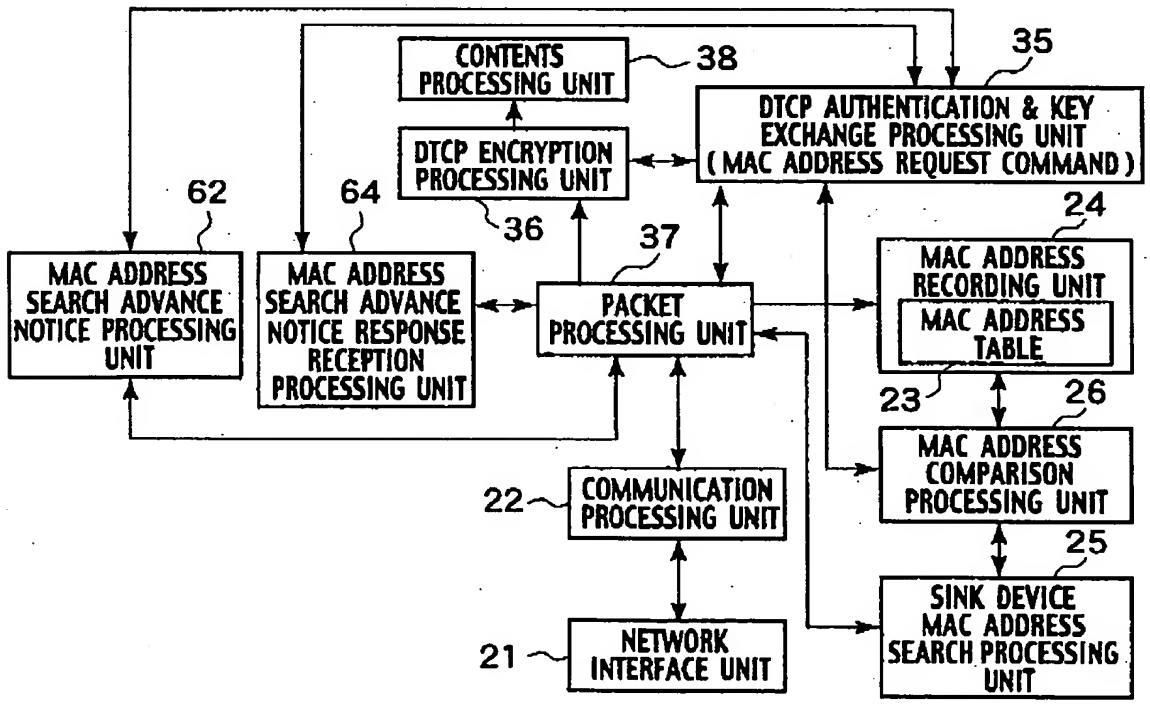
CONTENTS PROCESSING UNIT
38
35
DTCP AUTHENTICATION & KEY EXCHANGE PROCESSING UNIT (MAC ADDRESS REQUEST COMMAND)
DTCP ENCRYPTION PROCESSING UNIT
36
62
64
37
24
MAC ADDRESS SEARCH ADVANCE NOTICE PROCESSING UNIT
MAC ADDRESS SEARCH ADVANCE NOTICE RESPONSE RECEPTION PROCESSING UNIT
PACKET PROCESSING UNIT
MAC ADDRESS RECORDING UNIT
MAC ADDRESS TABLE
23
26
MAC ADDRESS COMPARISON PROCESSING UNIT
22
COMMUNICATION PROCESSING UNIT
25
SINK DEVICE MAC ADDRESS SEARCH PROCESSING UNIT
21
NETWORK INTERFACE UNIT

FIG. 31

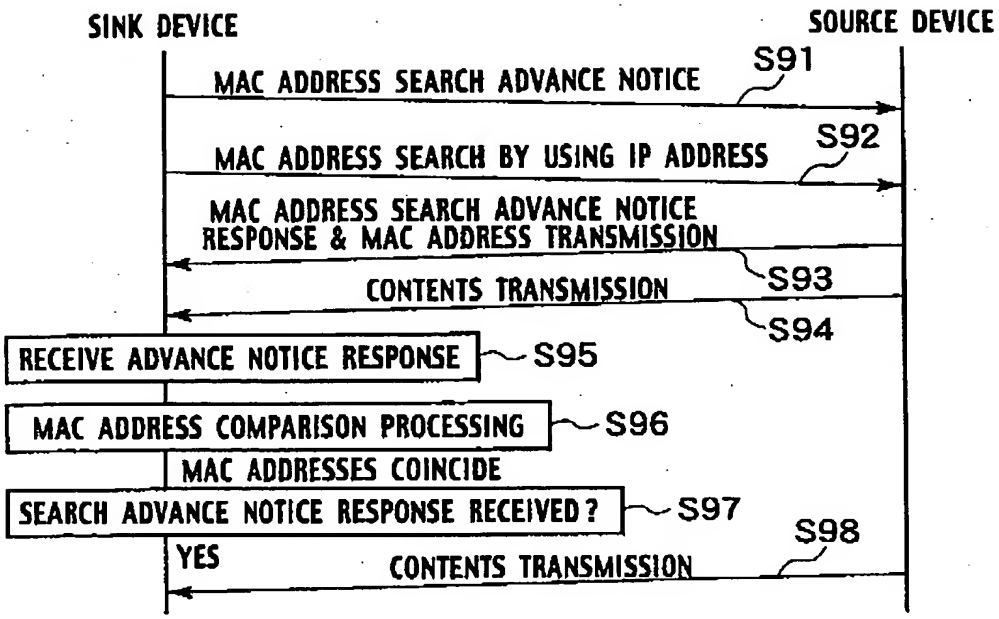
SINK DEVICE
SOURCE DEVICE
MAC ADDRESS SEARCH ADVANCE NOTICE
S91
MAC ADDRESS SEARCH BY USING IP ADDRESS
S92
MAC ADDRESS SEARCH ADVANCE NOTICE RESPONSE & MAC ADDRESS TRANSMISSION
S93
CONTENTS TRANSMISSION
S94
RECEIVE ADVANCE NOTICE RESPONSE
S95
MAC ADDRESS COMPARISON PROCESSING
S96
MAC ADDRESSES COINCIDE
SEARCH ADVANCE NOTICE RESPONSE RECEIVED?
S97
YES
CONTENTS TRANSMISSION
S98

FIG. 32

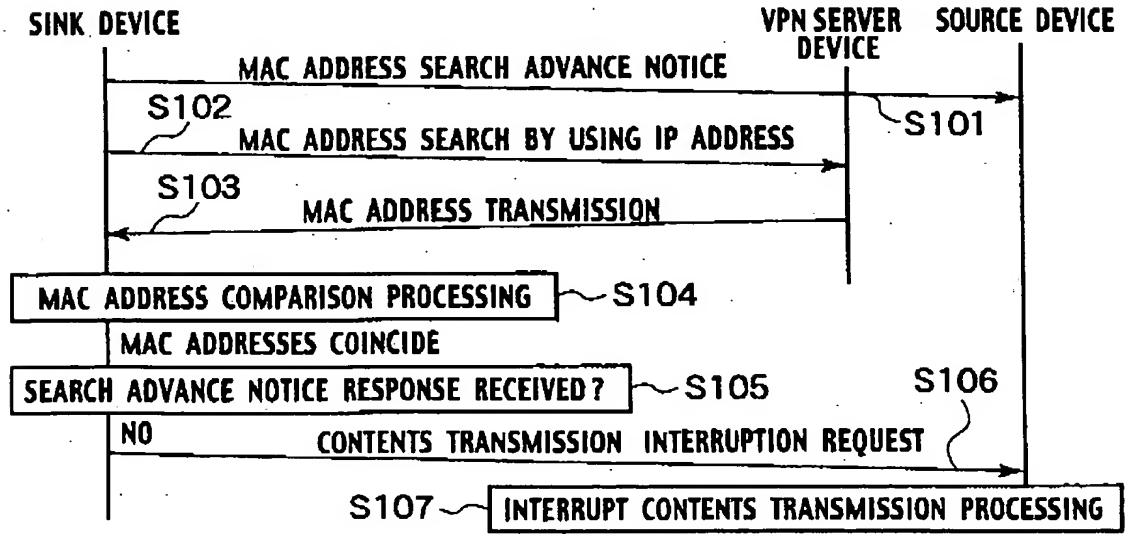
SINK DEVICE
VPN SERVER DEVICE
SOURCE DEVICE
MAC ADDRESS SEARCH ADVANCE NOTICE
S101
S102
MAC ADDRESS SEARCH BY USING IP ADDRESS
S103
MAC ADDRESS TRANSMISSION
MAC ADDRESS COMPARISON PROCESSING
S104
MAC ADDRESSES COINCIDE
SEARCH ADVANCE NOTICE RESPONSE RECEIVED?
S105
S106
NO
CONTENTS TRANSMISSION INTERRUPTION REQUEST
S107
INTERRUPT CONTENTS TRANSMISSION PROCESSING

FIG. 33
PRIOR ART

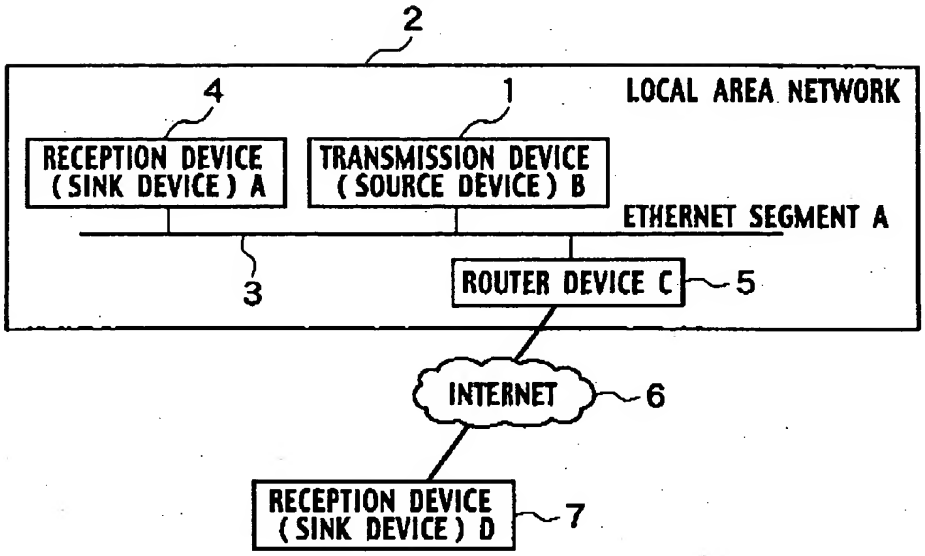

FIG. 34
PRIOR ART

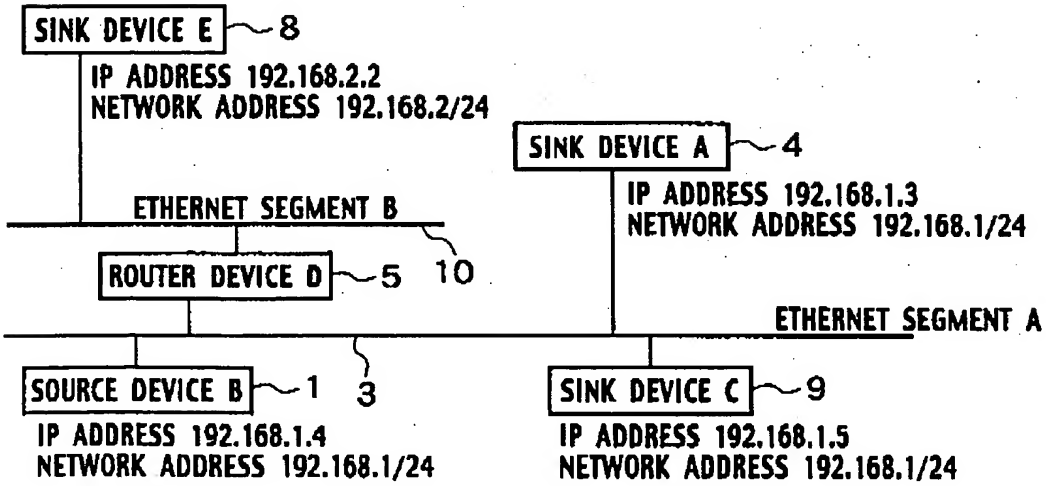

FIG. 35
PRIOR ART

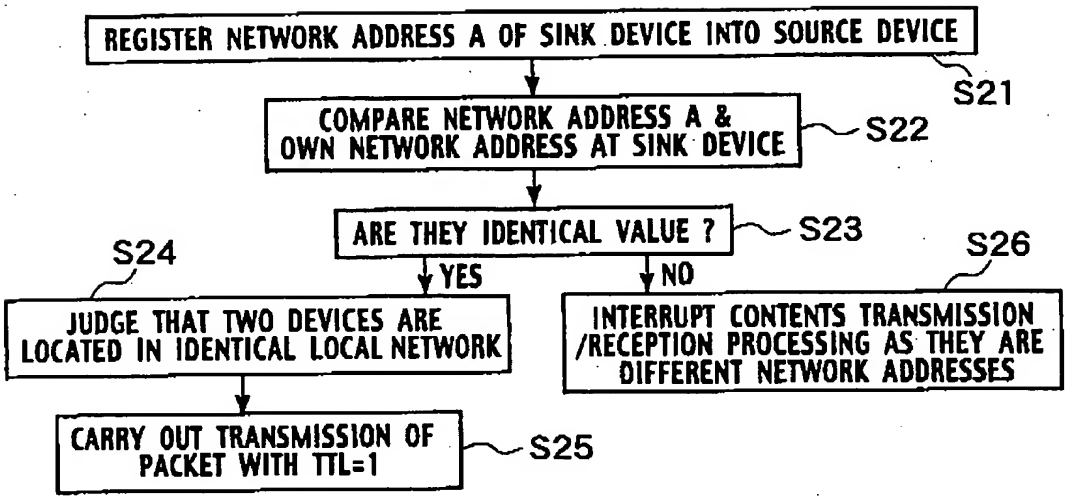
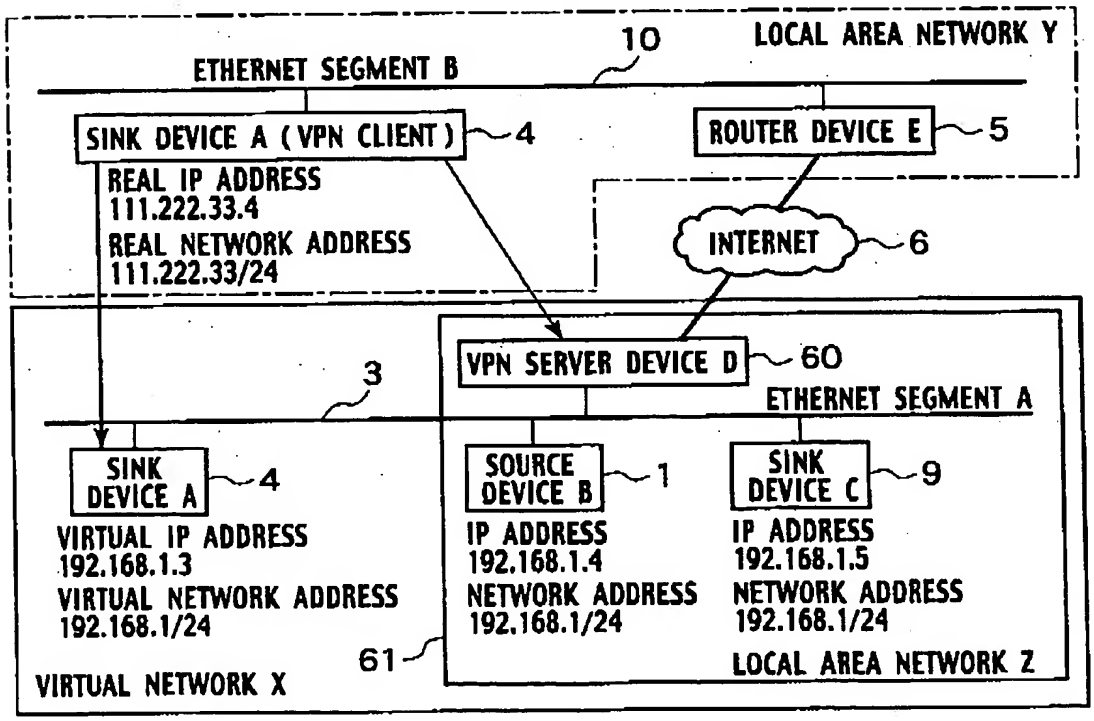
FIG. 36
PRIOR ART